CLAIMS

What is claimed is:

1. A method of transferring variable-length data frames across a synchronous network employing a multiple-channel synchronous transport signal to carry data among nodes of the network, wherein each channel of the synchronous transport signal carries data in fixed-size payloads, comprising:

encapsulating each data frame in a corresponding point-to-point frame, each point-to-point frame including a body portion of the corresponding data frame and a length value, the length value being located at a predetermined position in a beginning portion of the point-to-point frame;

dividing each point-to-point frame into a corresponding set of fixed-sized segments, a first one of the segments of each set carrying the beginning portion of the corresponding point-to-point frame such that the length value is located at a predetermined position in the first segment;

transmitting the segments of each point-to-point frame as a corresponding set of payloads of at least one channel of the synchronous transport signal, each set of payloads being marked so as to be identifiable in a stream of payloads of the at least one channel of the synchronous transport signal;

receiving each set of payloads of the at least one channel of the synchronous transport signal, and from each received set of payloads regenerating the corresponding point-to-point frame based at least in part on the length value from the first segment; and

de-capsulating each regenerated point-to-point frame to recover the corresponding data frame.

2. A method according to claim 1, wherein the segments of the point-to-point frames are transmitted as corresponding sets of

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payloads of at least two channels of the synchronous transport signal, but the segments of each point-to-point frame are carried in payloads of only a single one of the at least two channels.

3. A method according to claim 2, wherein each point-to-point frame also includes a sequence number identifying its temporal position among the point-to-point frames carrying the data frames, and further comprising re-ordering the point-to-point frames regenerated from the received sets of payloads based on the respective sequence numbers so as to recover the data frames according to an original ordering.

4. A method according to claim 2, further comprising selecting which of the at least two channels of the synchronous transport signal is to carry each point-to-point frame based on channel load balancing criteria.

5. A method according to claim 4, wherein each channel has associated therewith a corresponding buffer for temporarily storing point-to-point frames to be transmitted via the channels of the synchronous transport signal, and wherein the load balancing criteria includes maintaining no more than a predetermined difference in the fullness of the buffers.

6. A method according to claim 1, wherein the payloads of each channel of the synchronous transport signal are arranged into multi-payload superframes, each superframe including overhead information common to all payloads of the superframe.

7. A method according to claim 6, wherein a superframe is permitted to include a payload containing the end of one point-to-point frame and a payload containing the beginning of another point-to-point frame.

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8. A method according to claim 1, wherein each set of payloads includes a payload marked as an end of frame payload, and wherein regenerating the point-to-point frame from a set of payloads includes determining, using the length value, a precise location within the segment carried by the end of frame payload at which the point-to-point frame ends.

9. A method according to claim 1, wherein the at least one channel is one channel in a first of multiple bundles of channels, the bundles being associated with different sets of users of the synchronous network.

10. A method according to claim 9, wherein the payloads in the channels of all the bundles are the same size.

11. A method according to claim 9, wherein each bundle is associated with a corresponding specific user within the set of users associated with the bundle, and wherein each point-to-point frame transmitted by a user is transmitted on the associated bundle and multicast to all other users of the associated set of users.

12. A method according to claim 11, wherein each point-to-point frame transmitted via the bundles of channels is dropped and continued within the synchronous network based on the identity of bundle.

13. A method according to claim 9, wherein the use of the bundle of channels is shared by all users in the set of users associated with the bundle.

14. A method according to claim 13, wherein the transmission of point-to-point frames on an associated bundle of channels is controlled by a scheduling process that allocates the use of each

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bundle among the associated set of users according to a predetermined bandwidth allocation scheme.

15. A method according to claim 14, wherein each point-to-point frame transmitted via the bundles of channels is dropped and re-transmitted within the synchronous network based on information within the point-to-point frame identifying a destination of the point-to-point frame within the network.

16. A method according to claim 15, wherein the destination information is destination information appearing in the data frame encapsulated within the point-to-point frame.

17. A method according to claim 15, wherein the destination information included in each point-to-point frame is generated from separate destination information included in the data frame encapsulated by the point-to-point frame.

18. A network device for transferring variable-length data frames across a synchronous network employing a multiple-channel synchronous transport signal to carry data among nodes of the network, wherein each channel of the synchronous transport signal carries data in fixed-size payloads, comprising:

encapsulation logic operative to encapsulate each data frame in a corresponding point-to-point frame, each point-to-point frame including a body portion of the corresponding data frame and a length value, the length value being located at a predetermined position in a beginning portion of the point-to-point frame;

segmentation logic operative to divide each point-to-point frame into a corresponding set of fixed-sized segments, a first one of the segments of each set carrying the beginning portion of the corresponding point-to-point frame such that the length value is located at a predetermined position in the first segment;

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transmitting circuitry operative to transmit the segments of each point-to-point frame as a corresponding set of payloads of at least one channel of the synchronous transport signal, each set of payloads being marked so as to be identifiable in a stream of payloads of the at least one channel of the synchronous transport signal;

receiving circuitry operative to (i) receive sets of payloads of at least another channel of the synchronous transport signal, and (ii) from each received set of payloads, regenerate a corresponding point-to-point frame based at least in part on a length value from a first segment thereof; and

de-capsulation logic operative to de-capsulate each regenerated point-to-point frame to recover the corresponding data frame.

19. A network device according to claim 18, wherein the encapsulation logic is further operative to include a sequence number with each point-to-point frame, the sequence number identifying the temporal position of the point-to-point frame among the point-to-point frames carrying the data frames, and further comprising re-sequencing logic operative to re-order the point-to-point frames regenerated from the received sets of payloads based on the respective sequence numbers so as to recover the data frames according to an original ordering.

20. A network device according to claim 18, further comprising selection logic operative to select which of the at least two channels of the synchronous transport signal is to carry each point-to-point frame based on channel load balancing criteria.

21. A network device according to claim 20, further comprising buffers associated with respective ones of the channels for temporarily storing point-to-point frames to be transmitted via the associated channels, each buffer providing information

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regarding its relative fullness, and wherein the load balancing criteria used by the selection logic includes maintaining no more than a predetermined difference in the fullness of the buffers.

22. A network device according to claim 18, wherein the payloads of each channel of the synchronous transport signal are arranged into multi-payload superframes, each superframe including overhead information common to all payloads of the superframe.

23. A network device according to claim 22, wherein a superframe is permitted to include a payload containing the end of one point-to-point frame and a separate payload containing the beginning of another point-to-point frame.

24. A network device according to claim 18, wherein each set of payloads includes a payload marked as an end of frame payload, and wherein the receiving circuitry is further operative to determine, using the length value of each received point-to-point frame, a precise location within the segment carried by the end of frame payload at which the point-to-point frame ends.

25. A network device according to claim 18, wherein the at least one channel is one channel in a first of multiple bundles of channels, the bundles being associated with different sets of users of the synchronous network.

26. A network device according to claim 25, wherein the payloads in the channels of all the bundles are the same size.

27. A network device according to claim 25, wherein each bundle is associated with a corresponding specific user within the set of users associated with the bundle, and wherein each point-to-point frame transmitted by a user is transmitted on the associated bundle and multicast to all other users of the

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associated set of users.

28. A network device according to claim 27, wherein each point-to-point frame transmitted via the bundles of channels is dropped and forwarded within the synchronous network based on the identity of bundle.

29. A network device according to claim 25, wherein the use of the bundle of channels is shared by all users in the set of users associated with the bundle.

30. A network device according to claim 29, wherein the transmission of point-to-point frames on an associated bundle of channels is controlled by a scheduling process that allocates the use of each bundle among the associated set of users according to a predetermined bandwidth allocation scheme.

31. A network device according to claim 30, wherein each point-to-point frame transmitted via the bundles of channels is dropped and forwarded within the synchronous network based on information within the point-to-point frame identifying a destination of the point-to-point frame within the network.

32. A network device according to claim 31, wherein the destination information is destination information appearing in the data frame encapsulated within the point-to-point frame.

33. A network device according to claim 31, wherein the destination information included in each point-to-point frame is generated from separate destination information included in the data frame encapsulated by the point-to-point frame.

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